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RESORT NO. 4 - PRELIMINARY SOIL REPORT

MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3-9-11

To:
KAISER-AETNA

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

OCTOBER 1, 1970

MUNICIPAL REFERENCE & RECORDS CENTER
City & County of Honolulu
City Hall Annex, 558 S. King Street
Honolulu, Hawaii 96813
WITHDRAWN

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

WALTER LUM
EDWARD WATANABE
EZRA KOIKE

3030 WAIALAE AVE., HONOLULU, HAWAII 96816 • TEL. 737-7931

October 1, 1970

KAISER-AETNA
P. O. Box 2997
Honolulu, Hawaii 96802

Gentlemen:

Subject: Resort No. 4 - Preliminary Soil Report
(for site grading design purposes)
Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11
Chapter 23, Revised Ordinances of
Honolulu, 1961 As Amended

The Resort Division area consists of resort, apartment and residential subdivisions.

In accordance with your request, preliminary soil explorations were made to cover the general area. This report concerns only the preliminary soil explorations at the site for the proposed Resort No. 4, Maunalua, Oahu, Hawaii. The site is in Kealakipapa Valley.

The borings generally indicated surface layers of stiff gray clay (adobe) underlain by sand, coral, mudrock and rock.

Some grading and filling of the site are contemplated. The earthwork should be done in accordance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended and the recommendations contained herein.

Light apartment structures may be constructed with ordinary footings or foundations.

High-rise buildings in the area will probably require relatively simple foundations. However, additional explorations should be made for the design of a specific structure and location.

The report includes a Boring Location Plan, boring logs, laboratory test results, recommendations and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

Ezra Koike

Ezra Koike
Professional Engineer
Hawaii No. 1450

EK:rmf

C O N T E N T S

RESORT NO. 4 - PRELIMINARY SOIL REPORT

MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3-9-11

SCOPE OF EXPLORATION

The Resort Division area consists of resort, apartment and residential subdivisions. This report concerns only the preliminary soil explorations at the site for the proposed Resort No. 4 at Maunalua, Oahu, Hawaii. The limits of this area are shown on Figure 1. The purpose of this exploration was to determine general soil conditions for site grading design purposes.

This report includes field exploration, laboratory tests and general recommendations for site grading and light building foundation design.

FIELD EXPLORATION

Thirteen borings were made at the site. The locations of these borings are shown on Figure 1, Boring Location Plan.

The borings were made with 3 and 4-in. diameter augers using tungsten carbide bits. Soil samples were recovered with a standard split spoon driven with a 140-lb hammer falling 30 inches.

Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions in the boring logs are generally made in accordance with the "Unified Soil Classification System."

LABORATORY TESTS

Laboratory tests for on-site soils included: natural water content, Atterberg limits, specific gravity, sieve analysis, AASHO T-180-57 density, expansion and CBR.

A list of the standard field and laboratory test methods used for this project is given in the Appendix.

A summary of the laboratory test results is given in Table IA.

GENERAL SITE CONDITIONS

The proposed Resort No. 4 site is located east of Kalanianaole Highway, generally south of the U. S. Coast Guard's Makapuu Point light house access road. The northern portion of the site generally slopes to the south at about a 1 to 5% gradient. The western section is essentially level. The section along the east side of the valley has a cross slope of from about 8% to about 45% or steeper. Grass covers most of the site with some kiawe and koa on the steeper slopes and along the highway. Loose rock and boulders were noted along the eastern section and in several places along the highway. The valley floor in general is evenly sloped and relatively free of brush and loose rock.

INTERPRETATION OF SOIL CONDITIONS

From the field exploration, the soils at the site may be generally described as follows:

Surface layers of about 1 to 14 ft of medium to stiff gray-brown plastic clay (adobe) generally underlain by

decomposed rock and mudrock in the western section, or sand and coral mixtures or rock in the eastern section to about 7 to 16 ft, the depths drilled. The deeper clay layers occur in the southwestern section.

Water was not noted in the borings during the field exploration.

For more detailed descriptions of soils encountered in the drill holes, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

The proposed plan is to grade the site for resort development with fills generally less than 10 to 15 ft in height.

If practicable, the surface layers of adobe soils and boulders should be stripped from the sidehill areas along the east and west perimeters, particularly if slope fills are contemplated in these areas.

Site Grading

All surface vegetation and miscellaneous debris should be cleared and removed prior to site filling. Localized soft pockets encountered during site preparations should be excavated and backfilled with compacted select material. Provisions to drain the site should be included during and after the completion of filling operations.

Grading work should be done in general conformance with the requirements of Chapter 23, Revised Ordinances of Honolulu, 1961 As Amended.

For the construction of fills, the following is recommended:

1. Rubble, loose boulders and unsuitable materials should be removed.

2. Stockpiles and loose surface soils should generally be removed or scarified and recompacted before the placement of fills.

3. Hard surfaces along existing access roads should be scarified down to stiff soils and recompacted to match the density of the surrounding soils.

4. Fill material may be approved on-site or borrow soils. If practicable, fill material imported to the site should be select soils with a plasticity index generally less than 20.

5. Loose surface soils along the sides and bottom of natural drainageways should be removed where fills are contemplated.

Subdrains should be placed in a herringbone pattern along the bottom of natural drainageways or dips before the placement of fill.

6. Fills should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level condition. As the fill is brought up, it should be continually keyed into the stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

7. Fills should be laid in 6-in. compacted layers with a relative density of at least 90% of AASHO T-180-57 density.

8. If clay (adobe) soils are used for fills, they should be placed preferably below 2 ft of finish grades and several feet from the face of fill slopes. Adobe fill should be kept less than 10 ft in height and preferably less than 8 ft. See attached sketch, Figure 2.

In general, "adobe" soil fills should not be placed on existing sidehill of adobe soils. The thickness of the adobe on any sidehill should be less than 8 ft. The thickness of the adobe may be increased if the over-all average slope of the site is 8 horizontal to 1 vertical or flatter.

9. If boulders are proposed to be used in the construction of fills, they should generally be placed along the toe sections of fill slopes and outside of probable building sites.

Before placing any boulders, the subgrade should be stripped to stiff natural ground and shaped to drain. A layer of granular filter material should be placed on the subgrade and the boulders placed on the filter layer. The void spaces between boulders should be filled with granular material. A blanket of filter material should be placed against the boulders before any earth fills are placed against the boulders. See attached sketch, Figure 3.

Slopes

In general, cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

The height of cut and fill slopes in plastic clays (adobe) should be limited to about 6 ft. For higher slopes up to about 12-ft height in adobe, the slopes should be faced with select material (see attached sketch, Figure 2) or flattened to 3 horizontal to 1 vertical slope.

For low cuts thru mixtures of rock and clinkers, slope ratios of 1-1/2 horizontal to 1 vertical or flatter may be used.

For low cuts (less than 5± ft in height) in rock that is fairly homogeneous, slope ratios of 3/4 horizontal to 1 vertical or flatter may be used.

If slope heights (top to toe) of greater than 15 ft are considered, 8-ft wide benches should be placed at height intervals of about 15 ft in both cuts and fills.

For protection against erosion, the runoff from rainstorms should be diverted by berms or ditches away from slopes whenever practicable.

The surface of fill slopes should be compacted by cat-tracking or with a sheepsfoot roller.

In general, slope planting is recommended on cut and fill slopes to minimize erosion.

Foundations

Light, short-span structures may be constructed at the site with ordinary footings or foundations.

High-rise buildings in this area will probably require relatively simple foundations. However, additional explorations should be made for the design of a specific structure and location.

For heavy or long-span or multiple-story structures, foundation explorations should be made at each building site to evaluate the ground conditions before foundations are designed.

The following may be used as a guide for foundation design for light, short-span structures:

1. Bearing values for a given soil vary with the size and depth of footings. For light, one and 2-story, short-span structures, bearing values of about 2000 p.s.f. may be used.

2. If soft spots or pockets of loose material are encountered in footing excavations or below a building area, they should be excavated and replaced with compacted select on-site or borrow soils.

3. Foundation design adjustments must be made if adobe soils are encountered at the footing level. Care should be taken that there is at least 2 ft of compacted select material below building footings in adobe areas.

4. Concrete slab on ground should be placed over a base course of 4 in. of well-graded gravel less than 3/4 in. and greater than 1/4 in. in size. The subgrade should be compacted and shaped to a level surface or to drain, if practicable, and generally should be kept slightly higher than the finish grade outside of the building.

5. In general, buildings and structures should be placed about 15 ft from the tops of slopes.

6. Construction of retaining walls on slopes should generally be avoided.

7. Good surface drainage away from the foundation of structures should be maintained and the site should be graded at all times to prevent ponding of water.

Roadway

In general, a rough estimate of the roadway pavement thickness for the light residential traffic anticipated is as follows:

1. Wearing course - 2-in. asphaltic concrete.
2. Base course - 6-in. base course over a prepared subgrade.

Provisions should be made in the contract documents to allow for local adjustments regarding subbase requirements in the field as ground conditions are exposed at subgrade levels. The subbase thickness will depend upon the type of material within the top 2 ft of subgrade.

The subgrade should be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade levels through the walls of catch basins which are placed in these low areas.

Utilities

Although the probability of differential settlements in localized areas is slight in this area, utilities should be placed after the fills are constructed. Utility lines should be designed with flexible joints, particularly where lines are connected to structures. Gravity flow lines should be made as steep as practicable.

Unforeseen or undetected conditions such as soft spots may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

PROPOSED SPECIFICATION FOR EARTHWORK

RESORT NO. 4

General Description

This item shall consist of clearing and grubbing, removing of existing structures, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and subsidiary work necessary to complete the grading.

Clearing, Grubbing and Preparing Areas to be Filled

Vegetation, concrete slabs and rubbish shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

Vegetable matter shall be removed from the surface upon which fill is to be placed. Topsoil and stockpiled soils shall be (1) stripped to stiff natural ground or (2) scarified and recompacted before the placement of fills. Topsoil encountered at finish grade shall be scarified and recompacted.

Hard surfaces along the existing access roads shall be scarified down to stiff soils and recompacted to match the density of the surrounding soil before the placement of fills.

Where fills are proposed in sidehill areas and gullies, loose material along the bottom and the sides shall be stripped down to stiff natural ground before the placement of fills. New fills shall be keyed into the stiff natural ground.

Subdrains shall be placed along the bottom and sides of the natural drainageways before the construction of fills. The locations of subdrains should be determined in the field after clearing and grubbing.

Where fills are made on sloping areas steeper than 5 horizontal to 1 vertical, the ground at the toe of the slope shall be benched to a generally level condition. As the fill is brought up, it shall be continually keyed into the stiff natural ground by the cutting of steps into the hillside and compacting the fill into these steps. Ground slopes which are flatter than 5 horizontal to 1 vertical shall be benched when considered necessary by the Soil Engineer.

Materials

Fill materials shall consist of approved on-site or borrow soils. The soils shall contain no more than a trace of organic matter. Fill material imported to the site shall be select soils with a plasticity index less than 20.

Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and thoroughly blade-mixed during the spreading to insure uniformity of material and water content within each layer.

No rocks or cobbles shall be allowed to nest and voids between rocks must be carefully filled and compacted with small stones or earth.

When the water content of the fill material is well below the optimum for compacting purposes, water shall be added until the water content assures a thorough bonding during the compacting process.

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to no less than 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is near the optimum water content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to insure the obtainment of the desired density.

Field density tests shall be made to get an indication of the compaction of the fill. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, that layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Excavation

Suitable material from excavation shall be used in the fill and unsuitable material from excavation shall be disposed of.

Boulder Fills

If boulders are proposed to be used in the construction of fills, they shall be placed along the toe section of slopes and at locations indicated on the plan. The subgrade shall be stripped to stiff natural ground and shaped to drain. A layer of filter material shall be placed on it. All voids between boulders shall be filled with smaller granular soils. A blanket of filter material shall be placed against the boulder fill before construction of earth fills behind or above the boulders.

Unforeseen Conditions

If unforeseen or undetected critical soil conditions such as soft spots are encountered during the field operation, corrective measures shall be made in the field as they are detected.

Rainy Weather

No fill material shall be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests indicate that the water content and density are as previously specified.

BORING LOGS

Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limits or sieve analysis test results.

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2"ϕ - 2" STANDARD SPLIT SPOON

BORING NO. 99 Sheet No. ____ of ____

Driller: Walter Lum Assoc. Date: MAY 23, 1970

Field Party: HASHIDA, MAESHIRO

Type of Boring: AUGER (ACKER ACE) Diam.: 4"

Elev.: 34 ± * Datum: —

Drill Bit: T.C. DRAG

Water Level				
Time	—			
Date	5-23-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler		Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 34 ± *?	0									
	SURFACE: SCATTERED BOULDERS										
(CH)	STIFF, DARK BROWN, CLAY		2"ϕ	B	99-A	-	31	ROCK FRAGMENT		-	25/.3' 10/.0' HAMMER BOUNCES
	LIGHT GRAY, ROCK										
		5	2"ϕ	H	99-B	-	ROCK	FRAGMENTS		-	25/.0' HAMMER BOUNCES
	END OF BORING @ 5'										

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

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Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140*
Drop: 30"

SAMPLER: 2"ϕ - 2" STANDARD SPLIT SPOON

BORING NO. 100 Sheet No. ____ of ____

Driller: Walter Lum Assoc. Date: MAY 23, 1970

Field Party: HASHIDA, MAESHIRO

Type of Boring: AUGER (ACKER ACE) Diam.: 4"

Elev.: 28' ± * Datum: —

Drill Bit: T.C. DRAG

Water Level				
Time	—			
Date	5-23-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV.= 28' ± *	0								
	SURFACE: SCATTERED BOULDERS									
(SM)	MEDIUM DENSITY, MOTTLED TAN BROWN, SILTY SAND W/TRACES OF CORAL		2"ϕ SS	100-A	-	16	-	-	-	
(CH)	COBBLE OR BOULDER W/ STIFF BROWN CLAY & TRACES OF CORAL	5	2"ϕ SS	100-B	-	18	-	-	-	30/.4'
(SM)	DENSE, MEDIUM-FINE, BROWN, SILTY SAND W/ CORAL	10	2"ϕ SS	100-C	-	13	-	-	-	17/.5'
	DENSE, BROWN, SILTY FINE SAND W/ CORAL FRAGMENTS	15	2"ϕ SS	100-D	-	13	-	-	-	19/.5'
	END OF BORING @ 16'									

* ELEVATION ESTIMATED FROM CONTOUR MAP

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Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2"ss - 2" STANDARD SPLIT SPOON

BORING NO. 101 Sheet No. ____ of ____

Driller: Walter Lum Assoc. Date: MAY 23, 1970

Field Party: HASHIDA, MAESHIRO

Type of Boring: AUGER (ACKER ACE) Diam.: 4"

Elev.: 28' ± * Datum: —

Drill Bit: T.C. DRAG

Water Level	NOT NOTICED			
Time	—			
Date	5-23-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 28' ± *	0								
(CH)	STIFF, GRAY BROWN, CLAY (ADOBE)		2"ss	101-A	-	38	-	-	-	
	STIFF, DARK BROWN, CLAY W/ CORAL									
	COBBLE OR BOULDER									
	STIFF, BROWN, CLAY W/CORAL FRAGMENTS	5	2"ss	101-B	-	32	-	-	-	
(SM)	MEDIUM DENSITY TO DENSE, BROWN, SILTY SAND W/ CORAL	10	2"ss	101-C	-	16	-	-	-	20/.5'
	FINE SAND	15								
			2"ss	101-D	-	52	-	-	-	
(CH)	MEDIUM, GRAY, CLAY									
	END OF BORING @ 16.5'									

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4
LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 102 Sheet No. ____ of ____
Driller WALTER LUM ASSOC. Date JUNE 1, 1970
Field Party LUNING, MEYER
Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"
Elev. 47'± * Datum —
Drill Bit T. C. DRAG

Water Level	NOT NOTICED			
Time	—			
Date	6-1-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 47'± *	0								
(CH)	MEDIUM TO STIFF, DARK GRAY, CLAY, W/ROOTS & TRACE OF CORAL			102-A	-	25	-	-	-	
	MOTTLED BROWN, DECOMPOSED ROCK W/ GRAY CLAY POCKETS	5		102-B	-	40	-	-	-	30/.2'
	END OF BORING @ 7.0'									HAMMER BOUNCES

*ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

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Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140 #
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 103 Sheet No. _____ of _____

Driller: WALTER LUM ASSOC. Date: JUNE 2, 1970

Field Party: MAKAULA, MEYER

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"

Elev.: 30' ± * Datum: _____

Drill Bit: T.C. DRAG

Water Level				
Time	11:45 AM			
Date	6-2-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV= 30'±	0								
(CH)	MEDIUM, GRAY BROWN, CLAY			103-A	-	44	-	-	-	
(CH)	STIFF, BROWN, CLAY W/DECOMPOSED LAVA ROCK (PUKA PUKA ROCK)	5		103-B	-	37	-	-	-	44
(CH)	STIFF, LIGHT BROWN CLAY W/TRACES OF CORAL & SAND	10				35				
	WHITE, CORAL W/ BROWN CLAY POCKETS			103-C	-	17 23	-	-	-	44
	END OF BORING @ 11.5'									HAMMER BOUNCES

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4
LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"SS - 2" O.D. THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 104 Sheet No. ____ of ____
Driller ____ Date JUNE 1, 1970
Field Party LUNING, MEYER
Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"
Elev. 14'± * Datum ____
Drill Bit T.C. DRAG

Water Level				
Time	—			
Date	6-1-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE BLOWS/0.5'
	ELEV. = 14'±*	0									
(CH)	MEDIUM, DARK GRAY-BRN, CLAY W/ROOTS		2"SS	104-A	-	25	-	-	-		
CH	MEDIUM, GRAY-BROWN, CLAY	5	2"S	104-B	104	54	68	2340	1680 1740		2/.5' 4/.5'
		10									
	BROWN, DECOMPOSED ROCK W/BROWN CLAY POCKETS		2"SS	104-C	-	55	-	-	-		43
	END OF BORING @ 11.5'										

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2"SS - 2" O.D. THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 105 Sheet No. _____ of _____

Driller: Walter Lum Assoc. Date: MAY 27, 1970

Field Party: LUNING, MEYER

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"

Elev.: 11.5'± * Datum: —

Drill Bit: T.C DRAG

Water Level	NOT NOTICED			
Time	1:30 PM			
Date	5-27-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE BLOWS/0.5'
	ELEV. = 11.5'± *	0									
(CH)	MEDIUM TO STIFF, DARK BROWN-GRAY, CLAY W/ROOTS & GRASS		2"SS	105-A	—	25	—	—	—		
(CH)	SOFT TO MEDIUM, GRAY BROWN, CLAY	5	2"S	105-B	105	57	67	2200	1200 1600		1/.5' 2/.5'
	WHITE, CORAL	10	2"SS	105-C	—	5	—	—	—		40/.3' HAMMER BOUNCES
(GM)	DENSE, TANNISH WHITE, SAND & CORAL W/ SOME CLAY	15	2"SS	105-D	—	3	—	—	—		50/.5'
	END OF BORING @ 15.5'										

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

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Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2"ϕ - 2" STANDARD SPLIT SPOON

BORING NO. 106 Sheet No. ____ of ____

Driller: Walter Lum Assoc. Date: MAY 27, 1970

Field Party: LUNING, MEYER

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"

Elev.: 11'± * Datum: —

Drill Bit: T.C. DRAG

Water Level	NOT NOTICED			
Time	10:30 AM			
Date	5-27-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 11'± *	0								
(CH)	STIFF, DARK BROWN, CLAY W/ROOTS		2"ϕ	106-A	-	26	-	-	-	
(CH)	SOFT TO MEDIUM, GRAY-BROWN, CLAY	5	2"ϕ	106-B	-	27	-	-	-	
(SM)	STIFF, BROWN, SILTY SAND W/ DECOMPOSED ROCK	10	2"ϕ	106-C	-	8	-	-	-	40/3" HAMMER BOUNCES
	END OF BORING @ 12'									

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140*
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 107 Sheet No. _____ of _____

Driller: WALTER LUM ASSOC. Date: MAY 27, 1970

Field Party: LUNING, MEYER

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"

Elev.: 11'± * Datum: —

Drill Bit: T.C. DRAG

Water Level	NOT NOTICED		
Time	3:45 PM		
Date	5-27-70		

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 11'± *	0								
(CH)	MEDIUM TO STIFF, DARK GRAY BROWN, CLAY W/ROOTS			107-A	—	5	—	—	—	
	REDDISH BROWN, SILTY CLAY W/ DECOMPOSED ROCK									
	END OF BORING @ 3.0'	5								

NOTE: FIVE DRILL HOLES WERE ATTEMPTED. ROCKY MATERIALS AT 2.0', 2.5', 2.0' AND 2.5' DEPTHS.

*ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 108 Sheet No. ____ of ____

Driller: WALTER LUM ASSOC. Date: MAY 28, 1970

Field Party: MAKAULA, SUZUKI

Type of Boring: AUGER (CONCORE A5-JR) Diam.: 4"

Elev.: 11.5'± * Datum: —

Drill Bit: T.C DRAG

Water Level	NOT NOTICED				
Time	—				
Date	5-28-70				

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV.= 11.5'± *	0								
(CH)	MEDIUM TO STIFF, DARK GRAY, CLAY			108-A	-	43	-	-	-	
(CH)	STIFF, GRAY, CLAY	5		108-B	-	62 45	-	-	-	
	DENSE, MOTTLED BROWN, SILTY SAND (CEMENTED)									
	REDDISH BROWN, MUDROCK	10		108-C	-	NO RECOVERY			-	20/.0'
	END OF BORING @ 10.0'									HAMMER BOUNCES

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4
LOCATION: Maunalua, Oahu, Hawaii
Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"
SAMPLER: 2"ϕ - 2" O.D. THIN WALL TUBE
2"ϕϕ - 2" STANDARD SPLIT SPOON

BORING NO. 109 Sheet No. ____ of ____
Driller WALTER LUM ASSOC. Date MAY 28, 1970
Field Party LUNING, MEYER
Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"
Elev. 14' ± * Datum ____
Drill Bit T.C. DRAG

Water Level				
Time	3:45 PM			
Date	5-28-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE BLOWS/0.5'
	ELEV. = 14' ± *	0									
(CH)	MEDIUM TO STIFF, GRAY-BROWN, CLAY W/ROOTS		2"ϕϕ	109-A	—	23	—	—	—		
	DECOMPOSED ROCK										
(CH)	MEDIUM, DARK GRAY-BROWN, CLAY W/SOME ROOTS	5	2"ϕ	109-B	108	35	80	3280	2000 2000		2/.5 3/.5'
CH	MEDIUM, LIGHT GRAY, CLAY	10	2"ϕϕ	109-C	—	61	—	—	—		
	MOTTLED BROWN, DECOMPOSED MUDROCK W/CLAY POCKETS	15	2"ϕϕ	109-D	—	30	—	—	—		56
	END OF BORING @ 16.5'										

*ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 110 Sheet No. ____ of ____

Driller: WALTER LUM ASSOC. Date: JUNE 1, 1970

Field Party: LUNING, MEYER

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"

Elev.: 12.5'± * Datum: —

Drill Bit: T.C. DRAG

Water Level				
Time	—			
Date	6-1-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV = 12.5'± *	0								
(CH)	STIFF, DARK GRAY-BROWN, CLAY W/ROOTS			110-A	–	37	–	–	–	
	GRAY-BROWN, CLAY	5		110-B	–	44	–	–	–	
(MH)	STIFF, BROWN, SILTY CLAY W/ DECOMPOSED ROCK	10		110-C	–	45	–	–	–	
	END OF BORING @ 11.5'									

* ELEVATION ESTIMATED FROM CONTOUR MAP

WALTER LUM ASSOCIATES

3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: RESORT NO. 4

LOCATION: Maunalua, Oahu, Hawaii

Tax Map Key: 3-9-11

HAMMER:
Weight: 140 #
Drop: 30"

SAMPLER: 2" STANDARD SPLIT SPOON

BORING NO. 111 Sheet No. ____ of ____

Driller: Walter Lum Assoc. Date: MAY 28, 1970

Field Party: LUNING, MEYER

Type of Boring: AUGER (MOBILE MINUTEMAN) Diam.: 3"

Elev.: 16'± * Datum: —

Drill Bit: T.C. DRAG

Water Level	NOT NOTICED			
Time	—			
Date	5-28-70			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test, N (Blows per foot) 0 10 20 30 40
	ELEV. = 16'± *	0								
(CH)	MEDIUM TO STIFF, DARK GRAY-BROWN CLAY W/ROOTS			III-A	-	27	-	-	-	
(CH)	MEDIUM TO STIFF, DARK GRAY-BROWN, CLAY W/TRACES OF ROOTS	5		III-B	-	38	-	-	-	
(CH)	STIFF, GRAY-BROWN, CLAY	10		III-C	-	38 37	-	-	-	
(ML)	STIFF, BROWN, CLAYEY SILT W/ DECOMPOSED ROCK									
	END OF BORING @ 11.5'									

* ELEVATION ESTIMATED FROM CONTOUR MAP

RESORT NO. 4

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	101	104	108	109
SAMPLE NO.	SURFACE	C (TOP)		C
DEPTH BELOW SURFACE		10'-11.5	SURFACE	10'-11.5'
DESCRIPTION	GRAY CLAY	GRAY-BROWN CLAY	GRAY CLAY	LIGHT GRAY CLAY
GRAIN-SIZE ANALYSIS (% Passing)				
Sieve				
1"	100			
1/2"	100			
#4	100			
#10	99.9			
#20	99.8			
#40	99.7			
#100	99.4			
#200	98.9			
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	68	73	88	136
Plastic Limit	20	31	22	33
Plasticity Index	48	42	66	103
Dilatancy	NONE	SLOW	NONE	NONE
Toughness	HIGH	MED-HIGH	HIGH	HIGH
Dry Strength	HIGH	HIGH	HIGH	HIGH
UNIFIED SOIL CLASSIFICATION	CH	CH	CH	CH
APPARENT SPECIFIC GRAVITY	2.92		2.94	
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)				
Molding Moisture, %	23.2		24.2	
Molding Dry Density, P.C.F.	105.3		101.2	
Swell upon saturation, %	13.6		7.7	
CBR at 0.1" Penetration	1.5		1.7	
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-57 Method ___)	A		A	
Dry to Wet or Wet to Dry	DRY TO WET		DRY TO WET	
Max. Dry Density (P.C.F.)	104.8		104.0	
Optimum Moisture (%)	23.8		23.0	

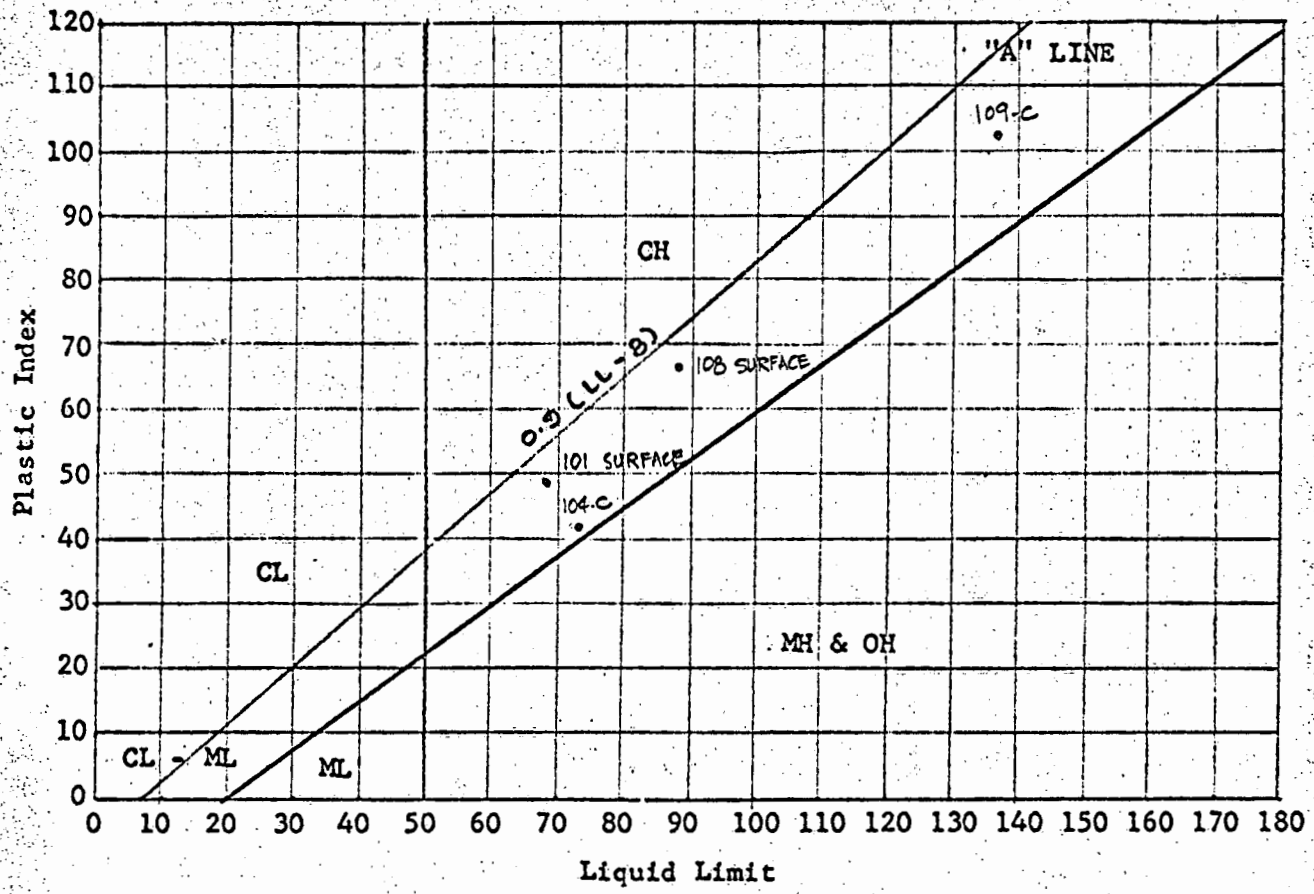
REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 8-20-70 By BT

JOB: RESORT NO. 4

LOCATION: MAUNALUA, OAHU, HAWAII



PLASTICITY CHART

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

MOISTURE–DENSITY CURVE (AASHO T-180-57, METHOD A)

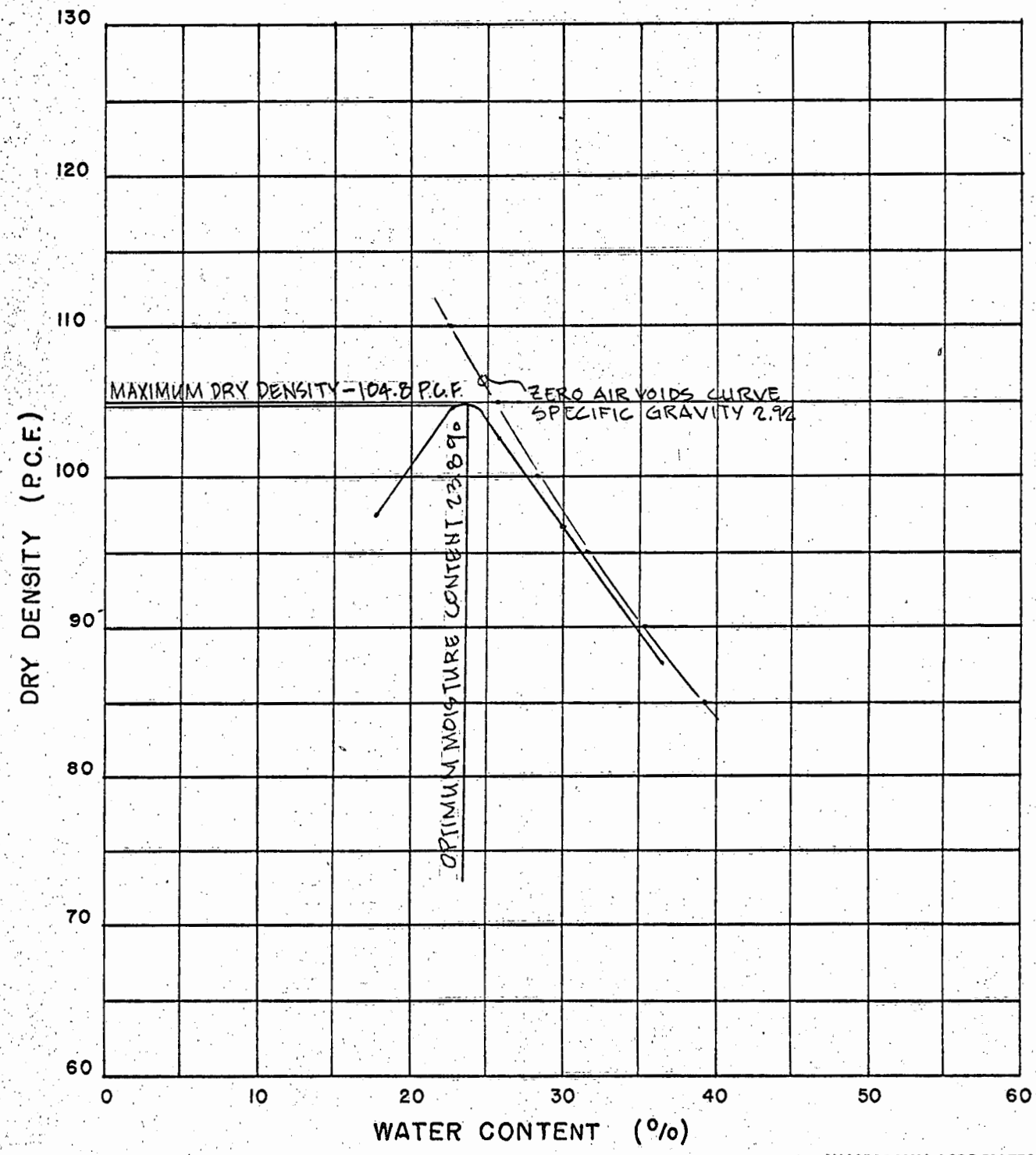
PROJECT: RESORT NO. 4

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO.: 101-SURFACE

SAMPLE DESCRIPTION: GRAY CLAY

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4" ϕ 4.59"
HAMMER: 10 LBS. 18" DROP
LAYERS: 5
BLOWS: 25 PER LAYER



WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DATE _____ BY _____

9-470

MOISTURE–DENSITY CURVE (AASHO T-180-57, METHOD A)

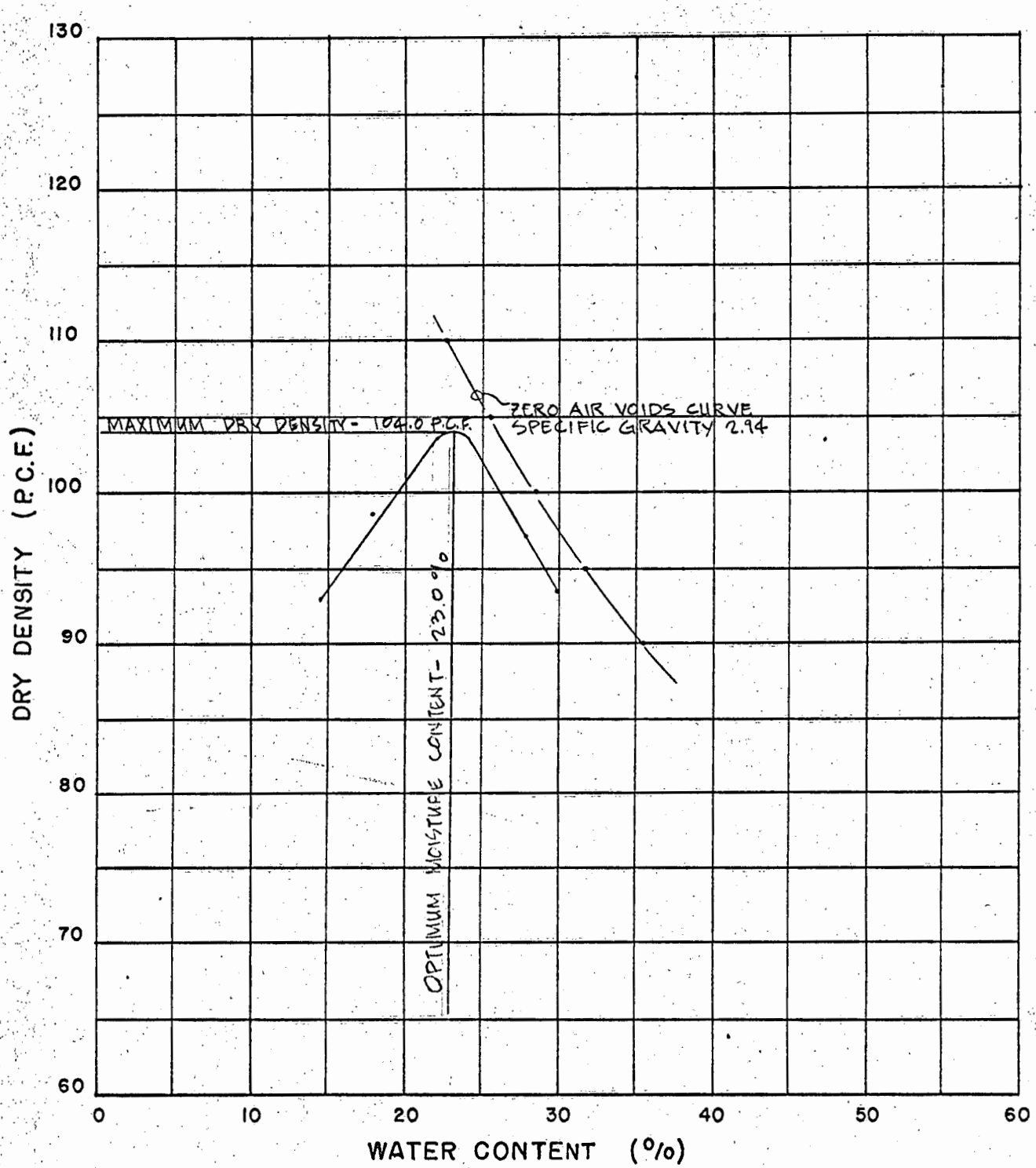
PROJECT: RESORT NO. 4

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO.: 108-SURFACE

SAMPLE DESCRIPTION: GRAY CLAY

AGGREGATE: 1/4" MINUS
MOLD SIZE: 4" & 4.59"
HAMMER: 10 LBS. 18" DROP
LAYERS: 5
BLOWS: 25 PER LAYER



WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DATE 8-10-70 BY S.T.

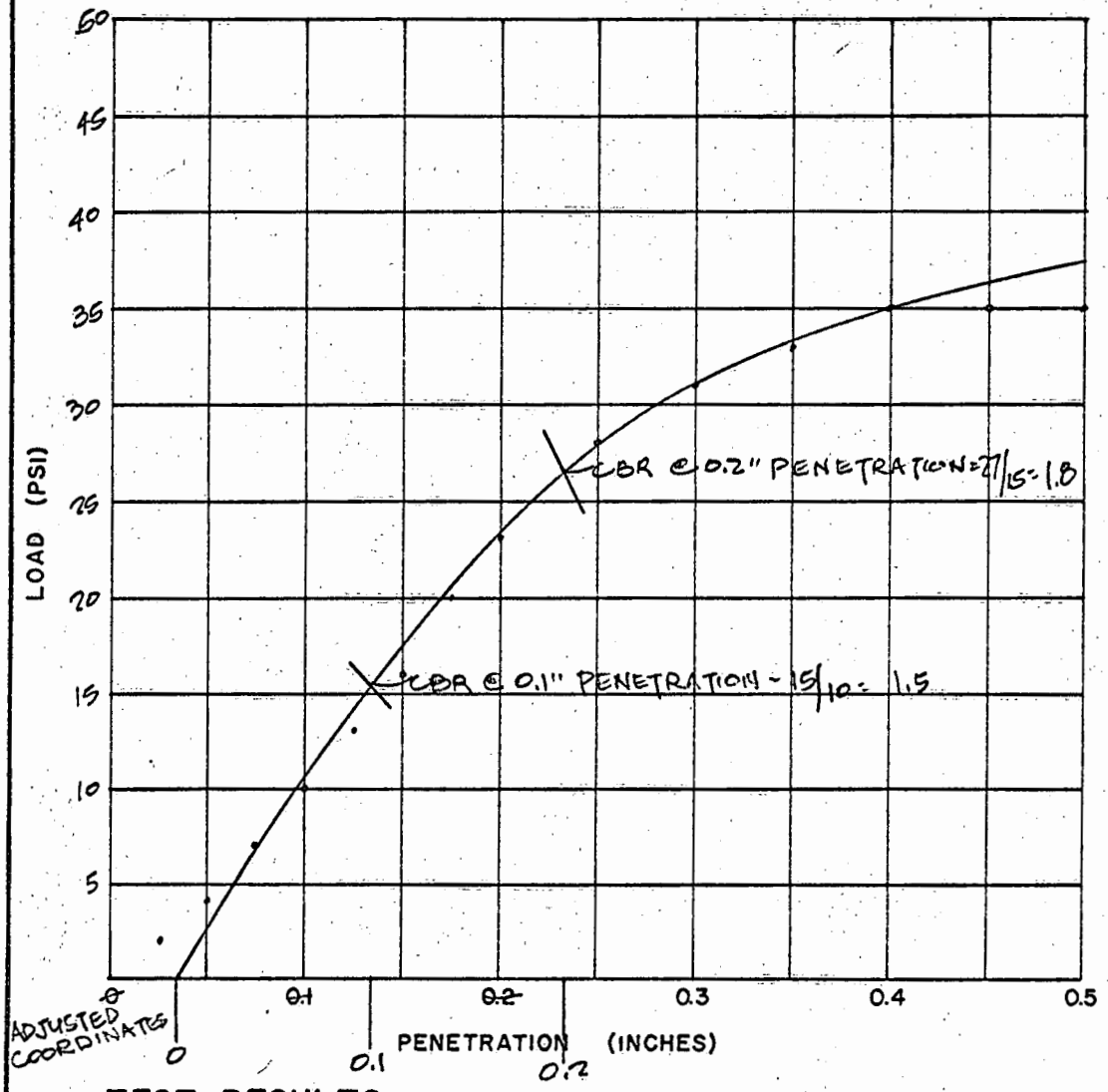
CBR TEST

PROJECT: RESORT NO. 4

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: 101-SURFACE

SAMPLE DESCRIPTION: GRAY CLAY



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	6	2
0.050	13	4
0.075	21	7
0.100	30	10
0.125	39	13
0.150	48	16
0.175	61	20
0.200	70	23
0.250	83	28
0.300	93	31
0.350	99	33
0.400	104	35
0.450	105	35
0.500	106	35

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS

HAMMER DROP 18"

No. OF BLOWS 56

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 23.2

MOLDING DRY DENSITY, P.C.F. 105.3

CBR @ 0.1" PENETRATION 1.5

DATE 8-5-70 BY R.M.

DATE 8-11-70 BY S.T.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

10-470

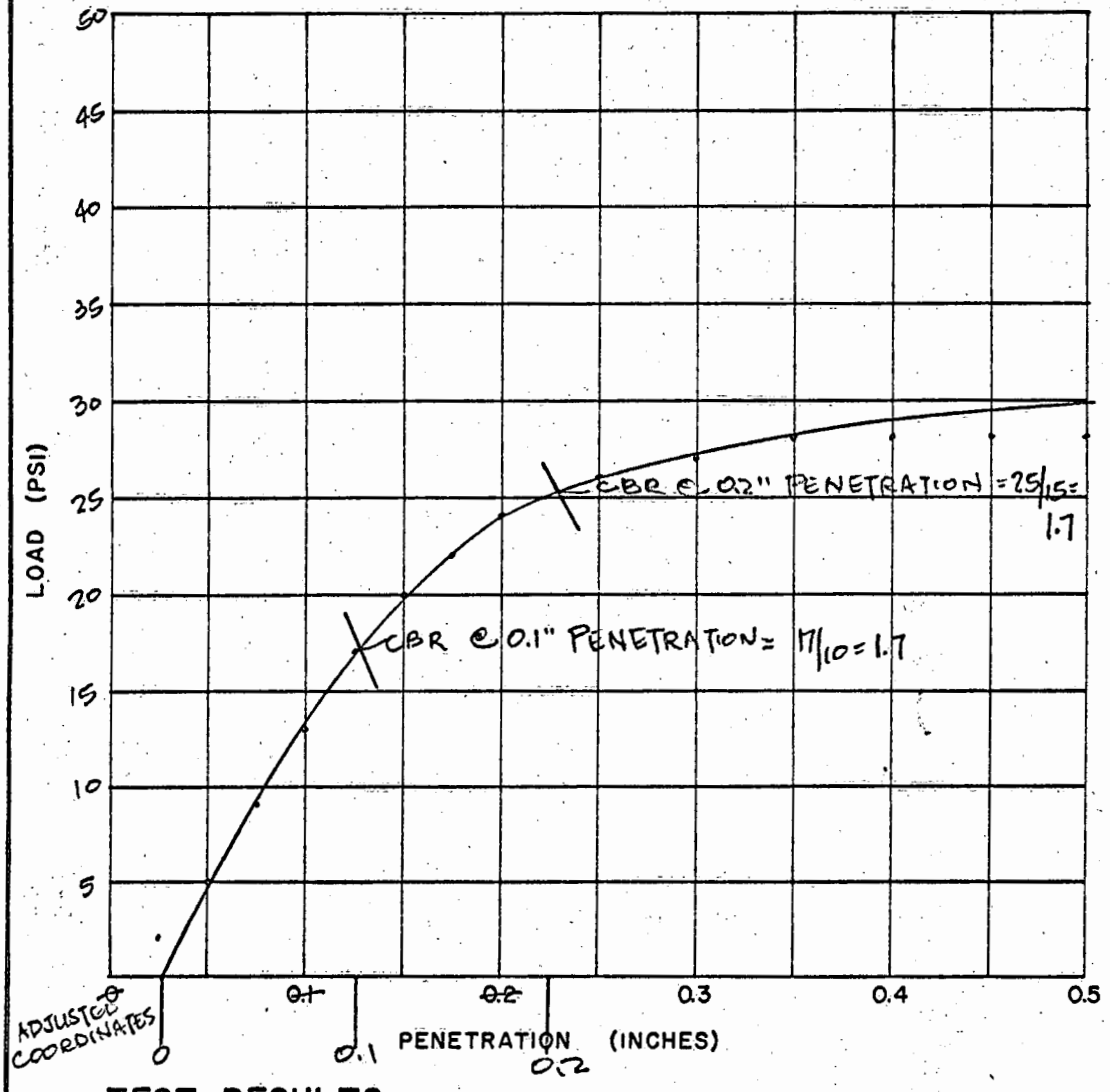
CBR TEST

PROJECT: RESORT NO. 4

LOCATION: MAUNALUA, OAHU, HAWAII

SAMPLE NO: 108-SURFACE

SAMPLE DESCRIPTION: GRAY CLAY



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	7	2
0.050	14	5
0.075	26	9
0.100	38	13
0.125	51	17
0.150	60	20
0.175	67	22
0.200	72	24
0.250	79	26
0.300	81	27
0.350	84	28
0.400	85	28
0.450	85	28
0.500	85	28

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS.

HAMMER DROP 18"

No. OF BLOWS 56

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 12.4

MOLDING DRY DENSITY, P.C.F. 111.9

CBR @ 0.1" PENETRATION 1.7

DATE 8-5-70 BY R.M.

DATE 8-11-70 BY S.T.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

GENERAL TESTING METHODS

EXPLORATORY BORINGS AND SAMPLING

Method for soil investigation and sampling by auger borings (Tentative)	ASTM Designation: D 1452-63T
Method for thin wall tube sampling of soils (Tentative)	ASTM Designation: D 1587-63T
Method for penetration test and split barrel sampling of soils (Tentative)	ASTM Designation: D 1586-64T

LABORATORY TESTING

Grading Analysis

Sieve analysis of fine and coarse aggregates	AASHO Designation: T 27-60
Amount of material finer than No. 200 sieve in aggregate	AASHO Designation: T 11-60

Atterberg Limits

Determining the liquid limit of soils Modified as follows: Substitute Casagrande grooving tool. Tests conducted from natural moisture content unless noted otherwise.	AASHO Designation: T 89-60
Determining the plastic limit of soils	AASHO Designation: T 90-56
Calculating the plasticity index of soils	AASHO Designation: T 91-54

Specific Gravity

Specific gravity of soils Modified as follows: 500 ML Pycnometer	AASHO Designation: T 100-60

Expansion and CBR Tests

Expansion test and California Bearing Ratio (CBR)	Section VIII - TM 5-530 "Materials Testing" by Headquarters, Dept. of the Army

Compaction Test

Moisture-Density relations of soils using a 10# rammer and an 18" drop	AASHO Designation: T 180-57

Unified Soil Classification

Designation E-3 from "Earth Manual" by the United States Department of the Interior Bureau of Reclamation

GENERAL TESTING METHODS

Consolidation Test

Chapter IX
"Soil Testing for Engineers"
by T. William Lambe
The Massachusetts Institute
of Technology

Laboratory Shear Test

Laboratory shear test using the Torvane

Brochure by Soiltest, Inc.

LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The boring logs indicate the approximate subsurface soil conditions encountered only at the drill holes where the borings were made at the times designated on the logs and may not represent conditions at other locations or at other dates. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments.

Our professional services were performed, findings obtained and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.

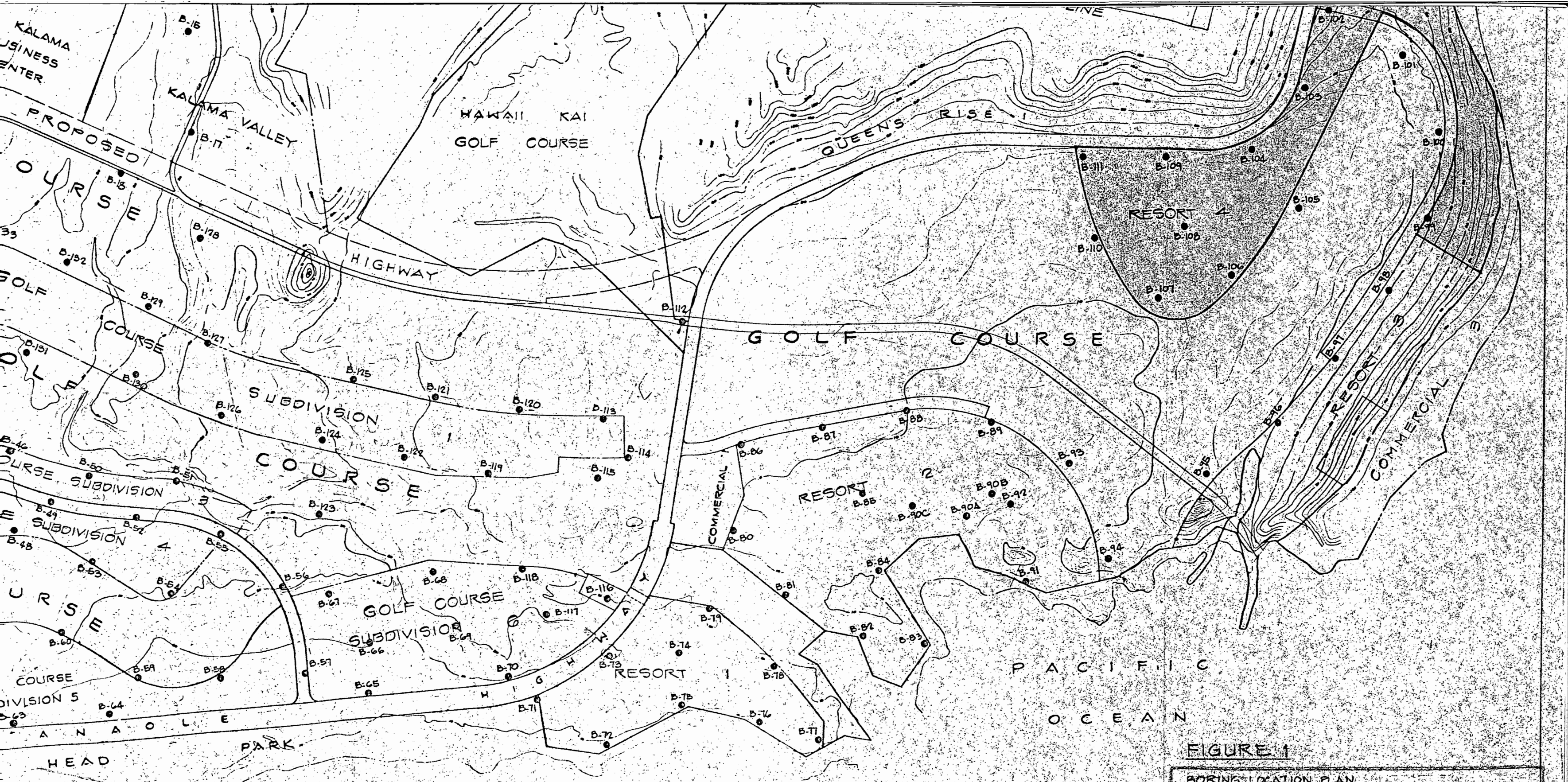


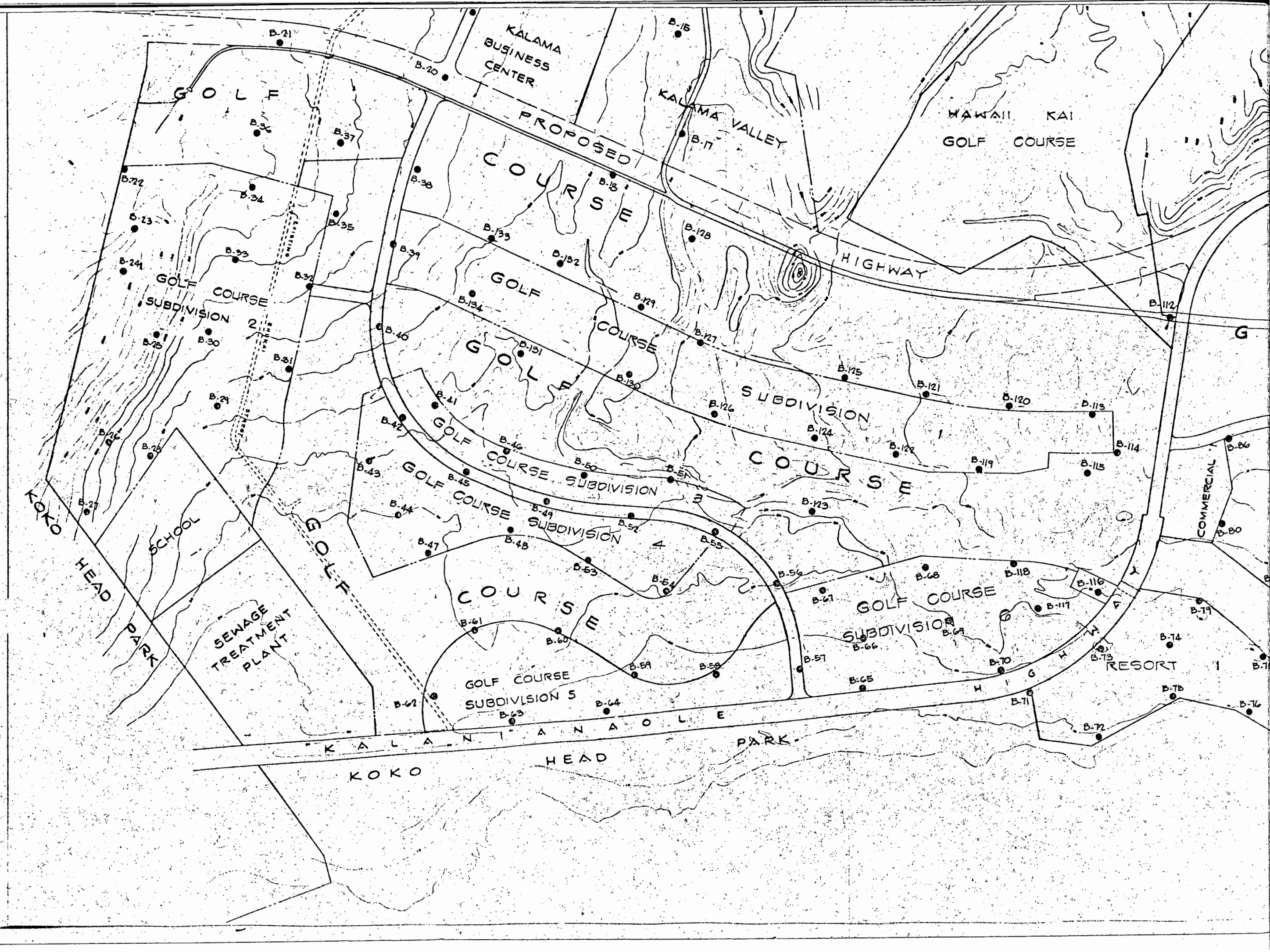
FIGURE 1

BORING LOCATION PLAN
RESORT No. 4
MAUNALUA, OAHU, HAWAII
TAX MAP KEY: 3 - 9 - 11

Dr. _____
Date 8/70
Rev. _____

WALTER LUM ASSOCIATES, INC.
3030 WAIALAE AVE.
CIVIL ENGINEERS
PHONE 737-7931

Sheet _____ of _____


KALAMA BUSINESS CENTER
KALAMA VALLEY
HAWAII KAI GOLF COURSE
PROPOSED GOLF COURSE
HIGHWAY
GOLF COURSE SUBDIVISION 2
GOLF COURSE SUBDIVISION 1
GOLF COURSE SUBDIVISION 3
GOLF COURSE SUBDIVISION 4
GOLF COURSE SUBDIVISION 5
GOLF COURSE SUBDIVISION 6
GOLF COURSE
SCHOOL
SEWAGE TREATMENT PLANT
KOKO HEAD PARK
KALANIANAOLE HIGHWAY
RESORT COMMERCIAL
B-10
B-11
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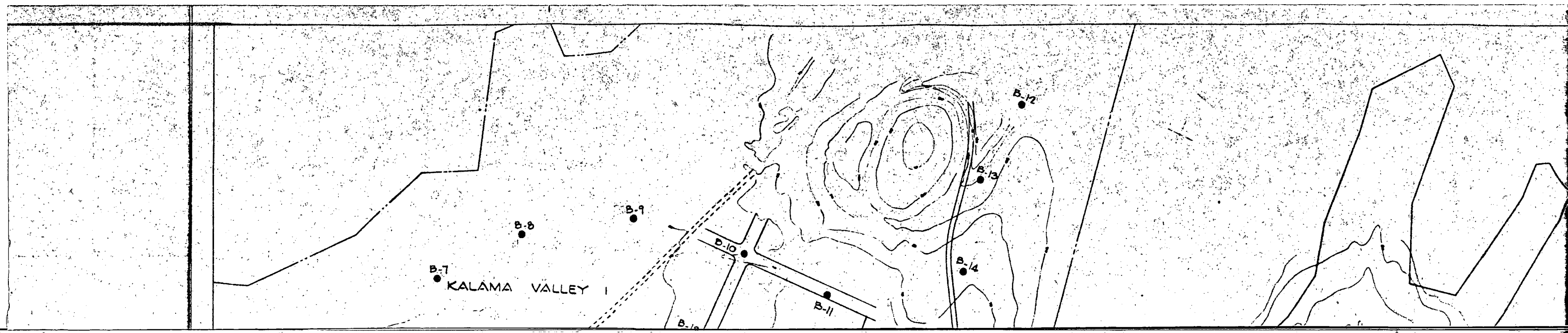
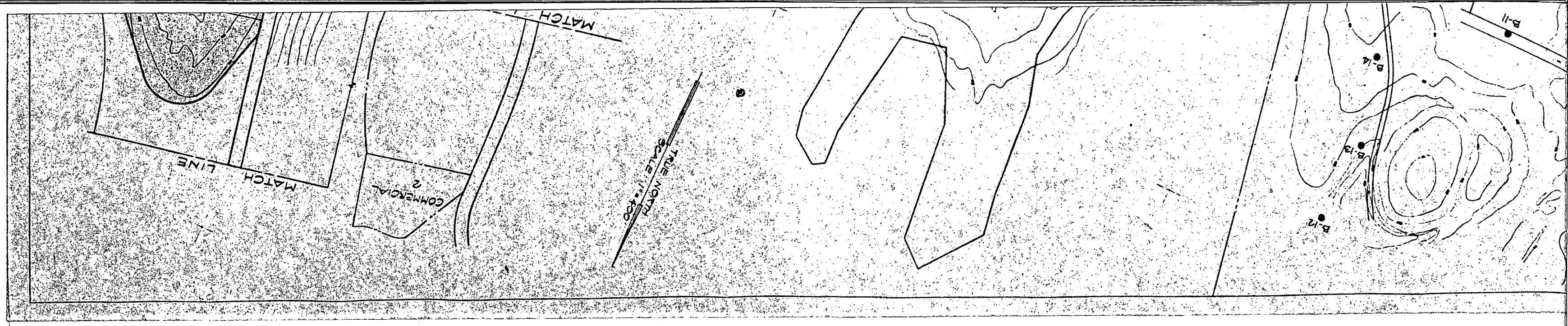
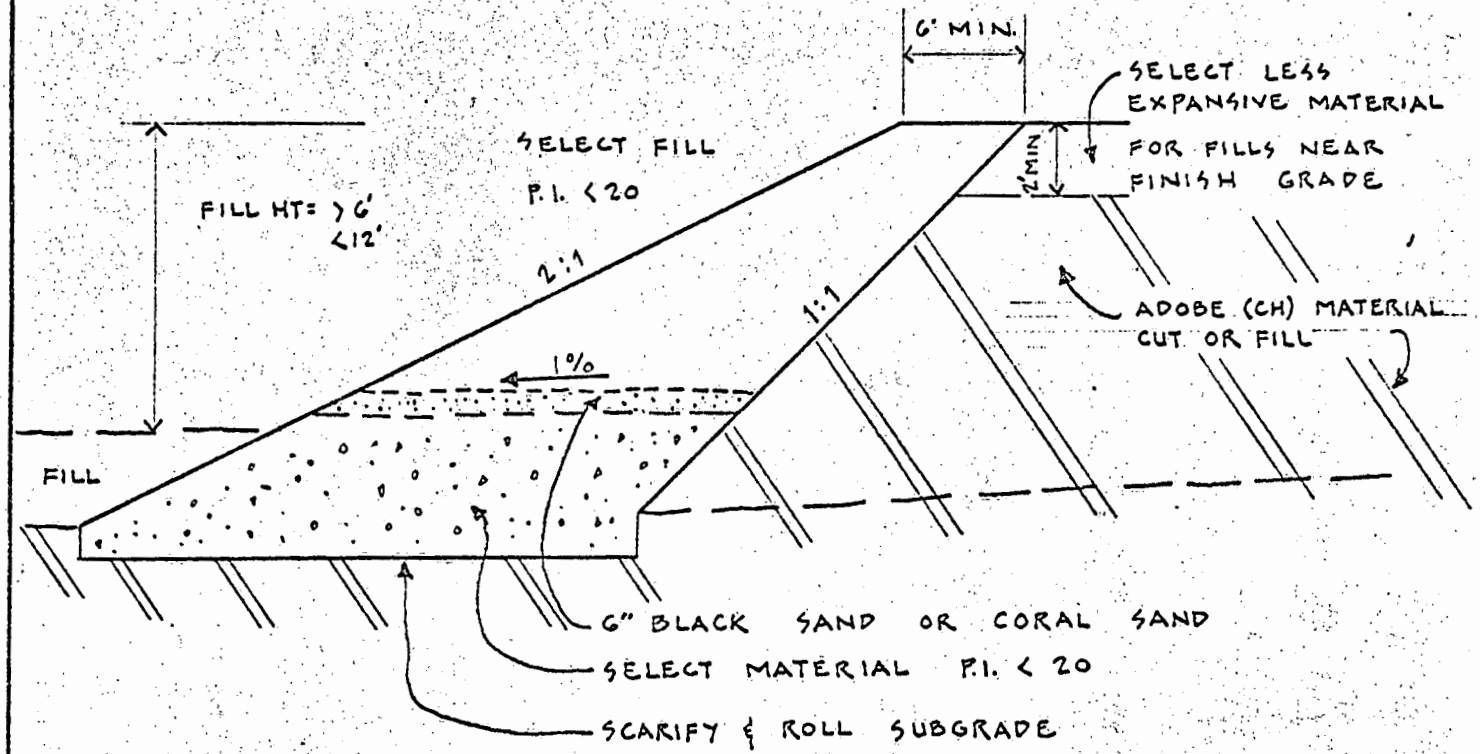
B-134


B-8
B-9
B-7
KALAMA VALLEY I
B-10
B-11
B-12
B-13
B-14


MATCH LINE
COMMERCIAL 2
MATCH
TRUE NORTH
SCALE 1" = 80'
B-11
B-14
B-13
B-12



SECTION

NOT TO SCALE

FIGURE 2

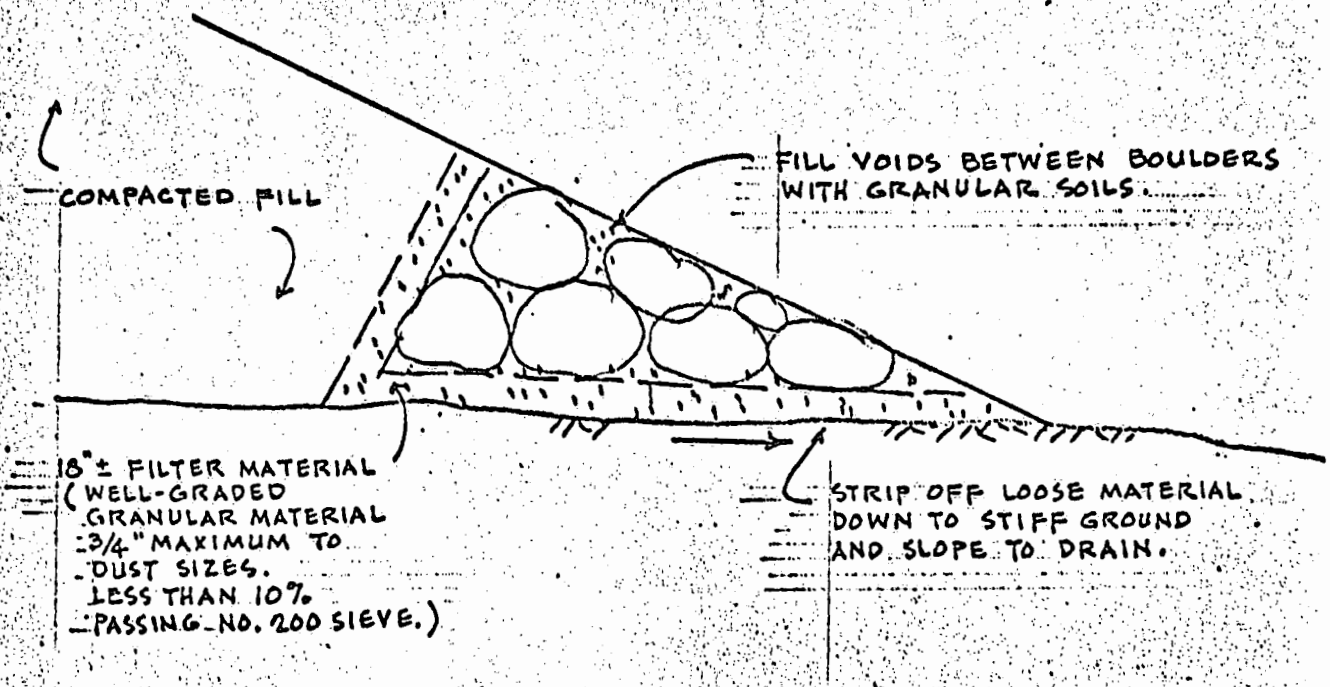
TYPICAL SLOPE TREATMENT FOR CUTS & FILLS IN ADOBE

RESORT NO. 4

MAUNALUA, OAHU, HAWAII

TAX MAP KEY: 3-9-11

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS



SECTION

NOT TO SCALE

FIGURE 3

PROPOSED BOULDER FILL

RESORT NO. 4

MAUNALUA, OAHU, HAWAII

TAX MAP KEY: 3-2-11

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS